Sewage Wastewater Treatment By Column Method Using Natural Adsorbents.

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Abstract- Water, a vital component of life, wastewater quality parameters are crucial for analyzing water that has been impacted by human or industrial activities. Treatment of waste water is done by many methods. In the present study, the quality parameters of wastewater are reduced by using natural adsorbent mixture, which is a mixture of wooden sawdust, ceramics from waste cups and saucers and river sand. The effectiveness in the treatment of wastewater is very high of using this mixture of adsorbent. The quality parameters are determined before and after treatment, which saw a reduction in TDS-91.2%, BOD-82.6%, COD-79.5%, hardness-94.3%, Sulphate-86.3%, Nitrate-60.6%, Chloride-70%, TSS-84.4%. The mean value flow rate is 15sec/liter. These materials saw their effectiveness in both acidic wastewater and basic wastewater.

Keywords-Adsorbent, sewage wastewater, wooden sawdust, filtration.

INTRODUCTION-

Water, a vital component of life, is a fascinating substance that shapes the Earth and supports all living beings. Covering about 71% of the planet's surface,[1] it exists in three forms—solid, liquid, and gas—adapting effortlessly to its surroundings. Its structure, made of two hydrogen atoms and one oxygen atom, gives it unique traits such as high surface tension, excellent solvent properties, and the ability to regulate temperatures.[2,3] Essential for hydration and ecosystems alike, water is deeply integrated into human existence, industries, and culture.[3] Its continuous cycle of evaporation, condensation, and precipitation highlights nature's incredible system of renewal and balance.[4] Wastewater quality parameters are crucial for analyzing water that has been impacted by human or industrial activities. These parameters evaluate physical, chemical, and biological traits to guide treatment and reuse efforts. Physical characteristics, such as color, turbidity, and temperature, provide initial information, while chemical properties, including pH, dissolved oxygen, biochemical oxygen demand (BOD), chemical oxygen demand (COD), and nutrient content, indicate pollution levels. Biological parameters assess the presence of microorganisms and pathogens, identifying potential risks.[4] Monitoring these factors ensures safe wastewater treatment, supports environmental sustainability, and helps adhere to regulatory standards for water management. Modern wastewater treatment focuses on removing pollutants effectively while minimizing environmental impact. Techniques such as filtration, sedimentation, and flotation are used to separate solid waste from water.[5] Advanced membranes are employed for fine particle removal. Chemicals like coagulants and flocculants help remove suspended particles. Advanced oxidation processes (AOPs) degrade organic contaminants using ozone, hydrogen peroxide, or UV light. [5,6] Microbial processes like activated sludge, bioreactors, and constructed wetlands break down organic matter. Anaerobic is also employed for energy recovery.[7] In this research we are trying to reduce the cost and time in the treatment of sewage waste water. In this research we are developing batches of natural adsorbent in a column to reduce the contamination and hazardous elements from sewage water of the local area. We use wooden saw

dust, ceramic powder of cups and saucers and acid-washed river sand, these adsorbents are natural and cost effective to use in treatment of waste water. In the column, the first batch of wooden saw dust, second batch of acid-washed sand and the third and last batch of ceramic of waste cups and saucers are introduced. Firstly, we will check the following (TABLE I

) Water quality parameters of sewage water before filtration from the column and then after filtration, then compare the data of water quality parameters before and after filtration from the column. The standard value of water quality parameters according to WHO guideline are as follow. (TABLE II).

TABLE I
Water Quality Parameters Will Be Determined. [7,8,9].

S. No.	Chemical Parameters	Physical Parameters	Biological parameters
1	Alkalinity	TDS	BOD
2	Sulphate	TSS	COD
3	Nitrate	TS	
4	Ca	Hardness	
5	Mg	Conductivity	
6	Chloride	Temperature	
7	pH	Turbidity	

TABLE II

S. No.	Quality Parameters	Standard Value
1	Total Alkalinity (TA)	600 mg/L
2	Total Hardness (TH)	500 mg/L
3	Total Dissolved Solid (TDS)	500 mg/L
4	Magnesium (Mg)	150 mg/L
5	Chloride (Cl-)	250 mg/L
6	BOD	2 mg/l
7	COD	10 mg/l
8	Sulfate:	250 mg/L
9	Nitrate:	50 mg/L
10	Turbidity	<5 NTU
11	Conductivity	400 micro-siemens/cm

WHO guidelines values of some physico-chemical parameters of drinking water.

MATERIAL AND METHOD-
Collection of wood-saw dust-
The wooden sawdust was collected from the furniture-making unit placed in Sardhana, Meerut, U.P. in white transparent polythene of 5kg. The amount of sawdust is 10Rs/Kg. After the collection it will be left for one day in sunlight to dry, after that leave for 5-6 Hours in distilled water to remove big particles of wood chips (fig.1) then filter and wash two times with distilled water to remove all pigment from the sawdust and then again leave for two days in sunlight to dry and remove moisture from it.

(fig.2). washed three times by two liters of distilled water till the pH become 7.8 and then left for one day in sunlight for dry. (fig-3)

Collection of waste ceramic materials:
All the waste of ceramic materials collected from the production companies of cups, saucers and pots are collected   after the collection, grind and crushed by pistol and mortar before being washed with distilled water to remove mud and dirt impurities and then dried in a hot air oven at 200 C at 30 minutes. Now sieved to separate 1mm to 2mm particles from 6mm to 8mm gravels and collect separately. Again, one time wash with distilled water and place in a hot air oven to remove all the moisture at 250 C for 2H and then store in air air-tight container for further use.

Collection of river sand:
The river sand was collected from a building material seller from Sardhana, Meerut at the rate of 30Rs/10Kg in a white transparent plastic box of 10kg and then sieve to remove big stones and gravels(fig-3) and then washed three times with distilled water and then left for two hours in dil.H2SO4 (0.03M) to remove all biological bacterial impurity after that washed three times by two liters of distilled water till the pH become 7.8 and then left for one day in sunlight for dry.(fig-4

2mm in diameter are made and place a soft foam at the end of the column to stop the flow of materials from the column. Now firstly, fill the dry wooden sawdust up to 6 inches height (FIGURE VI) (a soft foam placed after each material) then fill river sand in it up to 3inch in height (FIGURE VII) then fill ceramic fine powder of 1mm-2mm and then gravels of ceramic up to 3inch in height. (FIGURE VIII).

FIGURE I **FIGURE II**
(Washing Of Sawdust). (Drying Of Sawdust).

FIGURE III **FIGURE IV**
(Sieving of River Sand). (River Sand)

FIGURE V **FIGURE VI**
(PVC pipe column) (PVC column with wooden sawdust)

PREPARATION OF COLUMN

To prepare a vertical column, a PVC pipe of 6 inches in diameter covered on the end by a PVC stopper cap is used. (FIGURE V) 10 round holes of

FIGURE VII   **FIGUREVIII**
(Column With River Sand)   (Column With Ceramic)

Collection of Sewage and laboratory waste water

Sewage wastewater was collected in 10 liters of the plastic container from the sewage of Sardhana, by using a mini water pump and placed for 2H to sedimentation. Now contain the waste in another 10-liter plastic bottle without sediment. Laboratory wastewater was collected from the running chemistry lab at the College of Meerut by adding a 15-liter bucket to the lab sink pipe [fig-9] and then allowing for two hours for sedimentation. After sediment, all the wastewater is stored for further use.

FIGURE IX
(Collection of sample-2).

METHOD

Firstly, the following water parameters (Table-1) are tested before the treatment of wastewater and then 3 liters of wastewater are transferred from the column to flow and collect the filtrate(Treated water) after filtration in a 1L glass beaker, for determination the water parameters. The process was done for both the samples of wastewater.

FIGURE-X   FIGURE XI
(FILTRATION)   (SAMPLE BEFORE AND AFTER)

RESULT AND CONCLUSION-

In both the samples of waste water, many types of hazardous elements and impurity are found. In the sample-1(Sewage waste water) have high TDS value which reduced by 88.1%, Alkalinity from 205 to 62(69.7%) reduced, BOD become 81.2% decrees, COD become reduced up to 79.6%. The most favorable treatment in hardness of wastewater, which reduced up to 92.2%, the turbidity reduced up to 95.5% by first filtration of sewage water. The overall reduction in different parameters is shown in table-3. In the sample-2 (Laboratory waste water) all the physical and chemical parameters are gracefully reduced as TDS-91.2%, BOD-82.6%, COD-79.5%, hardness-94.3%, Sulphate-86.3%, Nitrate-60.6%, Chloride-70%, TSS-84.4% reduced by first filtration. The overall reduction in different parameters in sample-2 is shown in table-4. The mean value flow rate is 15sec/liter. In the sample-1 the alkalinity is 205mg/l which show the basic nature of wastewater but in laboratory wastewater the alkalinity is zero, which saw that the laboratory sample of wastewater is acidic in nature after the filtration by natural adsorbent are successfully maintain the alkalinity in both the sample.

TABLE III

Wastewater Parameters Before and After Filtration Of Sample-1.

S.No.	Parameters	Before Filtration	After Filtration	Units
1	Alkalinity	205	62	mg/l
2	Sulphate	388	45	mg/l
3	Nitrate	25.4	10	mg/l
4	Ca	105	42	mg/l
5	Mg	179	35	mg/l
6	Chloride	35	15	mg/l
7	pH	10.8	8.1	
8	TDS	3140	364	Ppm
9	TSS	1234	158	Ppm
10	TS	4374	522	ppm
11	Hardness	1868	145.6	mg/l
12	Conductivity	3867	561	microsiemens/cm
13	Temperature	23	22	C
14	BOD	309	58	mg/l
15	COD	522	106	mg/l
16	Turbidity	270	8	NTU

TABLE IV

Wastewater Parameters Before And After Filtration Of Sample-2.

S.No.	Quality Parameters	Before Filtration	After Filtration	Units
1	Alkalinity	0.02	36	mg/l
2	Sulphate	411	56	mg/l
3	Nitrate	35.6	14	mg/l
4	Ca	84	35	mg/l
5	Mg	146	47	mg/l
6	Chloride	66	19.6	mg/l
7	pH	2.5	8.1	
8	TDS	4160	364	Ppm
9	TSS	1014	158	Ppm
10	TS	5174	522	Ppm
11	Hardness	2212	124.5	mg/l
12	Conductivity	5821.53	476	microsiemens/cm
13	Temperature	23	22	C
14	BOD	421	73	mg/l
15	COD	655	134	mg/l
16	Turbidity	322	7	NTU

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CONCLUSION-

The wastewater of sewage and chemical laboratories has many harmful elements. It can be treated by natural adsorbent, by which we can reduce the cost of treatment of wastewater. The treatment of wastewater by these natural adsorbents saw most effective reduction in the TDS-91.2% and hardness-94%. The use of a mixture of wooden sawdust, ceramic and river-sand saw an effective result in the treatment of wastewater. This can be further modified as needed to treat bacterial contamination by UV and chlorination. The overall result is, it is a low-cost filtration method to treat sewage water at both low and high levels. The reduction efficiency of the mixture is very effective in the column method. All the absorbents have their different properties to decrease the pollution and element concentration in wastewater.

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